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**U.S. Department of Justice**
Office of Justice Programs
*National Institute of Justice*

# National Institute of Justice

Law Enforcement and Corrections Standards and Testing Program

# Guide for the Selection of Personal Protective Equipment for Emergency First Responders (Percutaneous Protection—Apparel)

## NIJ Guide 102–00

## Volume IIc

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# ABOUT THE LAW ENFORCEMENT AND CORRECTIONS STANDARDS AND TESTING PROGRAM

The Law Enforcement and Corrections Standards and Testing Program is sponsored by the Office of Science and Technology of the National Institute of Justice (NIJ), U.S. Department of Justice. The program responds to the mandate of the Justice System Improvement Act of 1979, which created NIJ and directed it to encourage research and development to improve the criminal justice system and to disseminate the results to Federal, State, and local agencies.

The Law Enforcement and Corrections Standards and Testing Program is an applied research effort that determines the technological needs of justice system agencies, sets minimum performance standards for specific devices, tests commercially available equipment against those standards, and disseminates the standards and the test results to criminal justice agencies nationally and internationally.

The program operates through:

The *Law Enforcement and Corrections Technology Advisory Council* (LECTAC) consisting of nationally recognized criminal justice practitioners from Federal, State, and local agencies, which assesses technological needs and sets priorities for research programs and items to be evaluated and tested.

The *Office of Law Enforcement Standards* (OLES) at the National Institute of Standards and Technology, which develops voluntary national performance standards for compliance testing to ensure that individual items of equipment are suitable for use by criminal justice agencies. The standards are based upon laboratory testing and evaluation of representative samples of each item of equipment to determine the key attributes, develop test methods, and establish minimum performance requirements for each essential attribute. In addition to the highly technical standards, OLES also produces technical reports and user guidelines that explain in nontechnical terms the capabilities of available equipment.

The *National Law Enforcement and Corrections Technology Center (NLECTC),* operated by a grantee, which supervises a national compliance testing program conducted by independent laboratories. The standards developed by OLES serve as performance benchmarks against which commercial equipment is measured. The facilities, personnel, and testing capabilities of the independent laboratories are evaluated by OLES prior to testing each item of equipment, and OLES helps the NLECTC staff review and analyze data. Test results are published in Equipment Performance Reports designed to help justice system procurement officials make informed purchasing decisions.

Publications are available at no charge through the National Law Enforcement and Corrections Technology Center. Some documents are also available online through the Internet/World Wide Web. To request a document or additional information, call 800–248–2742 or 301–519–5060, or write:

National Law Enforcement and Corrections Technology Center
P.O. Box 1160
Rockville, MD 20849–1160
E-Mail: *asknlectc@nlectc.org*
World Wide Web address: *http://www.nlectc.org*

The National Institute of Justice is a component of the Office of Justice Programs, which also includes the Bureau of Justice Assistance, Bureau of Justice Statistics, Office of Juvenile Justice and Delinquency Prevention, and the Office for Victims of Crime.

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# Guide for the Selection of Personal Protective Equipment for Emergency First Responders (Percutaneous Protection—Apparel)

**NIJ Guide 102–00, Volume IIc**

Dr. Alim A. Fatah[1]
John A. Barrett[2]
Richard D. Arcilesi, Jr.[2]
Charlotte H. Lattin[2]
Charles G. Janney[2]
Edward A. Blackman[2]

Coordination by:
Office of Law Enforcement Standards
National Institute of Standards and Technology
Gaithersburg, MD 20899–8102

Prepared for:
National Institute of Justice
Office of Science and Technology
Washington, DC 20531

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NCJ ######

[1]National Institute of Standards and Technology, Office of Law Enforcement Standards.
[2]Battelle Memorial Institute.

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**National Institute of Justice**

Sarah V. Hart
Director

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Alim A. Fatah, Program Manager for
Chemical Systems and Materials, and
Kathleen M. Higgins, Director of OLES.

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sponsored by the National Institute of Justice (NIJ).

## FOREWORD

The Office of Law Enforcement Standards (OLES) of the National Institute of Standards and Technology (NIST) furnishes technical support to the National Institute of Justice (NIJ) program to support law enforcement and criminal justice in the United States. The function of OLES is to develop standards and conduct research that will assist law enforcement and criminal justice agencies.

OLES is: (1) subjecting existing equipment to laboratory testing and evaluation, and (2) conducting research leading to the development of several series of documents, including national standards, user guides, and technical reports.

This document covers research conducted by OLES under the sponsorship of NIJ. Additional reports as well as other documents are being issued under the OLES program in the areas of protective clothing and equipment, communications systems, emergency equipment, investigative aids, security systems, vehicles, weapons, and analytical techniques and standard reference materials used by the forensic community.

Technical comments and suggestions concerning this guide are invited from all interested parties. They may be addressed to the Office of Law Enforcement Standards, National Institute of Standards and Technology, 100 Bureau Drive, Stop 8102, Gaithersburg, MD 20899–8102.

Sarah V. Hart, Director
National Institute of Justice

## ACKNOWLEDGMENTS

We thank Ms. Kathleen Higgins and Dr. Alim Fatah of the National Institute of Standards and Technology (NIST) for programmatic support and for numerous valuable discussions concerning the contents of this document. Mr. Bill Haskell of the U.S. Army Soldier and Biological Chemical Command (SBCCOM), Mr. Richard Vigus of SBCCOM, Ms. Priscilla S. Golden of General Physics, and Mr. Todd Brethauer representing the Technical Support Working Group (TSWG)[3] also reviewed the document and provided numerous useful comments. In addition, the authors want to acknowledge and thank the emergency first responders who reviewed the document and responded with positive and helpful comments.

We wish to acknowledge the Personal Protection and Operational Equipment (PPE) subgroup of the InterAgency Board (IAB) for Equipment Standardization and Interoperability. The IAB (made up of government and first responder representatives) was commissioned by the Attorney General of the United States in conjunction with the Department of Defense's Director of Military Support. The IAB was established to ensure equipment standardization and interoperability and to oversee the research and development of advanced technologies to assist first responders at the State and local levels in establishing and maintaining a robust crisis and consequence management capability.[4]

We also sincerely thank all vendors who provided us with information about their products.

[3]The Technical Support Working Group (TSWG) is the U.S. national forum that identifies, prioritizes, and coordinates interagency and international research and development (R&D) requirements for combating terrorism. Through the Department of Defense's Combating Terrorism Technology Support Program and funding provided by other agencies, the TSWG rapidly develops technologies and equipment to meet the high-priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with major allies.

[4]The Marshall Convention, Standardized Weapons of Mass Destruction (WMD) Response Force Equipment and InterOperability, 2 to 4 November 1999.

# CONTENTS

## COMMONLY USED SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| A | ampere | h | hour | oz. | ounce |
| ac | alternating current | hf | high frequency | No. | number |
| AM | amplitude modulation | Hz | hertz | o.d. | outside diameter |
| cd | candela | i.d. | inside diameter | Ω | ohm |
| cm | centimeter | in | inch | p. | page |
| CP | chemically pure | IR | infrared | Pa | pascal |
| c/s | cycle per second | J | joule | pe | probable error |
| d | day | L | lambert | pp. | pages |
| dB | decibel | L | liter | ppm | parts per million |
| dc | direct current | lb | pound | qt | quart |
| °C | degree Celsius | lbf | pound-force | rad | radian |
| °F | degree Fahrenheit | lbf·in | pound-force inch | rf | radio frequency |
| dia | diameter | lm | lumen | rh | relative humidity |
| emf | electromotive force | ln | logarithm (base e) | s | second |
| eq | equation | log | logarithm (base 10) | SD | standard deviation |
| F | farad | M | molar | sec. | Section |
| fc | footcandle | m | meter | SWR | standing wave ratio |
| fig. | Figure | μ | micron | uhf | ultrahigh frequency |
| FM | frequency modulation | min | minute | UV | ultraviolet |
| ft | foot | mm | millimeter | V | volt |
| ft/s | foot per second | mph | miles per hour | vhf | very high frequency |
| g | acceleration | m/s | meter per second | W | watt |
| g | gram | mo | month | λ | wavelength |
| gal | gallon | N | newton | wk | week |
| gr | grain | N·m | newton meter | wt | weight |
| H | henry | nm | nanometer | yr | year |

area=unit$^2$ (e.g., ft$^2$, in$^2$, etc.); volume=unit$^3$ (e.g., ft$^3$, m$^3$, etc.)

### ACRONYMS SPECIFIC TO THIS DOCUMENT

| | | | |
|---|---|---|---|
| ASTM | American Society for Testing and Materials | NIJ | National Institute of Justice |
| BW | Biological Warfare | NIOSH | National Institute for Occupational Safety and Health |
| CB | Chemical and Biological | NIST | National Institute of Standards and Technology |
| CBW | Chemical Biological Warfare | NATO | North Atlantic Treaty Organization |
| CPU | Collective Protective Undergarment | NBC | Nuclear, Biological, and Chemical |
| CW | Chemical Warfare | OSHA | Occupational Safety and Health Administration |
| DOD | Department of Defense | PAPR | Powered Air Purifying Respirator |
| DTAPS | Disposable Toxicological Agent Protective Suit | PF | Protection Factor |
| DPG | Dugway Proving Grounds | PICS | Personal Ice Cooling System |
| DRES | Defense Research Establishment Suffield | POL | Petroleum, Oils, and Lubricants |
| ECBE | Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD | PPE | Personal Protective Equipment |
| EOD | Explosive Ordnance Disposal | PPV | Positive Pressure Ventilation |
| EPA | Environmental Protection Agency | PVC | Polyvinyl chloride |
| ERDEC | U.S. Army Edgewood Research, Development and Engineering Center | SBCCOM | U.S. Army Soldier and Biological Chemical Command |
| FBI | Federal Bureau of Investigation | SCBA | Self-Contained Breathing Apparatus |
| FR | Fire Resistant | STB | Super Tropical Bleach |
| HAZMAT | Hazardous Materials | TAP | Toxicological Agent Protective |
| IDLH | Immediately Dangerous to Life and Health | TICs | Toxic Industrial Chemicals |
| IAB | Interagency Board | TIMs | Toxic Industrial Materials |
| ITAR | International Traffic and Arms Regulations | TOP | Test Operating Procedure |
| NFPA | National Fire Protection Association | TSWG | Technical Support Working Group |

**PREFIXES (See ASTM E380)**

| | | | |
|---|---|---|---|
| d | deci ($10^{-1}$) | da | deka (10) |
| c | centi ($10^{-2}$) | h | hecto ($10^{2}$) |
| m | milli ($10^{-3}$) | k | kilo ($10^{3}$) |
| µ | micro ($10^{-6}$) | M | mega ($10^{6}$) |
| n | nano ($10^{-9}$) | G | giga ($10^{9}$) |
| p | pico ($10^{-12}$) | T | tera ($10^{12}$) |

**COMMON CONVERSIONS**

| | |
|---|---|
| 0.30480 m =1 ft | 4.448222 N = 1 lbf |
| 25.4 mm = 1 in | 1.355818 J = 1 ft·lbf |
| 0.4535924 kg = 1 lb | 0.1129848 N m = 1 lbf·in |
| 0.06479891g = 1gr | 14.59390 N/m = 1 lbf/ft |
| 0.9463529 L = 1 qt | 6894.757 Pa = 1 lbf/in$^2$ |
| 3600000 J = 1 kW·hr | 1.609344 km/h = 1 mph |

psi = mm of Hg x ($1.9339 \times 10^{-2}$)

mm of Hg = psi x 51.71

Temperature: $T\,{}^{\circ}_{C} = (T\,{}^{\circ}_{F} - 32) \times 5/9$

Temperature: $T\,{}^{\circ}_{F} = (T\,{}^{\circ}_{C} \times 9/5) + 32$

# EXECUTIVE SUMMARY

The National Institute of Justice is the focal point for providing support to State and local law enforcement agencies in the development of counterterrorism technology and standards, including technology needs for chemical and biological defense. In recognizing the needs of State and local emergency first responders, the Office of Law Enforcement Standards (OLES) at the National Institute of Standards and Technology (NIST), supported by the National Institute of Justice, the Technical Support Working Group (TSWG), the U.S. Army Soldier and Biological Chemical Command, and the Interagency Board for Equipment Standardization and Interoperability (IAB), is developing chemical and biological defense equipment guides. The guides will focus on chemical and biological equipment in areas of detection, personal protection, decontamination, and communication. This document focuses specifically on assisting the emergency first responder community in the evaluation and purchase of personal protective equipment.

The long range plans are to: (1) subject existing personal protective equipment to laboratory testing and evaluation against a specified protocol, and (2) conduct research leading to the development of multiple series of documents, including national standards, user guides, and technical reports. It is anticipated that the testing, evaluation, and research processes will take several years to complete; therefore, the National Institute of Justice has developed this initial guide for the emergency first responder community in order to facilitate their evaluation and purchase of personal protective equipment.

In conjunction with this program, additional guides, as well as other documents, are being issued in the areas of chemical agent and toxic industrial material detection equipment, biological agent detection equipment, decontamination equipment, and communication equipment.

This Volume, IIc, of the *Guide for the Selection of Personal Protective Equipment for Emergency First Responders*, which focuses on percutaneous (skin) protection other than garments—herein referred to as apparel (e.g., hoods, labcoats, and gloves). It contains the information data sheets that were used to support the personal protective equipment evaluation detailed in Volume I. The compilation of data in Volume IIc is the result of the merger of several data acquisition methods used independently by NIST and TSWG.

The information contained in this guide has been obtained through literature searches and market surveys. The vendors were contacted multiple times during the preparation of this guide to ensure data accuracy. In addition, the information is supplemented with test data obtained from other sources (e.g., Department of Defense), if available. It should also be noted that the purpose of this guide is not to provide recommendations but rather to serve as a means to provide information to the reader to compare and contrast commercially available personal protective equipment. *Reference herein to any specific commercial products, processes, or services by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government. The information and statements contained in this guide shall not be used for the purposes of advertising, nor to imply the endorsement or recommendation of the United States Government.*

*With respect to information provided in this guide, neither the United States Government nor any of its employees make any warranty, expressed or implied, including but not limited to the warranties of merchantability and fitness for a particular purpose. Further, neither the United States Government nor any of its employees assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed.*

Technical comments, suggestions, and product updates are encouraged from interested parties. They may be addressed to the Office of Law Enforcement Standards, National Institute of Standards and Technology, 100 Bureau Drive, Stop 8102, Gaithersburg, MD 20899–8102. It is anticipated that this guide will be updated periodically.

Questions relating to the specific devices included in this document should be addressed directly to the proponent agencies or the equipment manufacturers. Contact information for each equipment item included in this guide can be found in this volume (Vol. IIc).

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# GUIDE FOR THE SELECTION OF PERSONAL PROTECTIVE EQUIPMENT FOR EMERGENCY FIRST RESPONDERS (PERCUTANEOUS PROTECTION—APPAREL)

This guide includes information intended to be useful to the emergency first responder community in the selection of personal protective equipment (PPE) that includes chemical and biological protective clothing and respiratory equipment for different applications. This Volume, IIc, of the *Guide for the Selection of Personal Protective Equipment for Emergency First Responders*, includes details on the 74 percutaneous protective items (apparel other than garments) that are referenced in Volume I.

## 1. INTRODUCTION

The *Guide for the Selection of Personal Protective Equipment for Emergency First Responders* includes information intended to be useful to the emergency first responder community in the selection of PPE (percutaneous and respiratory). Due to the large number of PPE items identified for the guide, the guide is separated into four volumes. Volume I serves as the selection tool for all PPE, while Volume IIa serves as a repository for the respiratory protective data sheets; Volume IIb serves as a repository for the percutaneous protective equipment (garments) data sheets, and Volume IIc serves as a repository for the percutaneous protective equipment (apparel) data sheets.

# 2. IDENTIFICATION OF PERSONAL PROTECTIVE EQUIPMENT

An extensive market survey was conducted to identify commercially available personal protective equipment. This market survey encompassed the assessment of past market surveys, identification of new equipment, and interaction with numerous equipment vendors.

## 2.1 Identification of New Equipment

A variety of sources were utilized to identify commercially available personal protective equipment, including a Commerce Business Daily (CBD) Announcement, literature searches, database searches, Internet searches, technical conferences, and technical contacts. These sources resulted in the identification of 74 percutaneous protective equipment items.

## 2.2 Vendor Contact

Vendors were contacted three separate times in order to obtain additional product information, as well as to finalize their specific equipment data for inclusion in the guide. An initial contact with vendors and manufacturers occurred the last quarter of 1999, when they received a facsimile or an electronic mail message that contained the definitions for the data fields. They were asked to supply information on vendor specific personal equipment items corresponding to the data field definitions.

The second contact occurred during the March/April 2000 time period in order to finalize the equipment data sheets and the information contained in the guide. This contact was conducted by facsimile and electronic mail. The vendors were given two weeks to review the information.

The third contact was made during February 2001. Each vendor received a facsimile or an electronic mail message that contained the data sheets for their specific equipment item(s), the selection factors that were developed to assist with the selection and purchase of the most appropriate equipment, and the results of the evaluation of the personal protective equipment against the selection factors. The vendors were asked to review the data sheets and tables for completeness and accuracy of the incorporated data. The vendors were given three weeks to review the information.

# 3. DATA FIELDS

Appendix E serves as a compendium of commercially available personal protective equipment. Each of the 74 identified percutaneous protective items is detailed within appendix E. Forty-nine data fields, as defined in this section, were used for providing information relating to the personal protective equipment. It is important to note that these data fields were developed using input from the emergency responder community.

The data fields are organized into the following five categories:

- General.
- Operational Parameters.
- Physical Parameters.
- Logistical.
- Special Requirements.

The remainder of this section defines each of the 49 data fields by category.

## 3.1 General Category

The General Category includes the following data fields:

1. Name.
2. ID #.
3. Technology.
4. Stock Number.
5. Protection Type.
6. Equipment Category.
7. Availability.
8. Current User.
9. Manufacturer.
10. Manufacturer Type.
11. Developer.
12. Source.
13. Certification.

Each of these data fields is defined in more detail in the remainder of this section.

### 3.1.1 Name

The Name data field is used to identify the name of the equipment.

### 3.1.2 ID #

The ID # data field is for identification purposes only.

### 3.1.3 Technology

The Technology data field identifies the material or process by which a piece of equipment supplies protection from chemical and biological agents, nuclear particulates, and/or toxic industrial materials (TIMs). Percutaneous protection is generally afforded by material technologies (such as carbon sphere materials, selectively-permeable or semi-permeable materials) or finish/treatment or coating add-ons (such as a water-repellant coating, an electrostatic finish, or a reactive coating).

### 3.1.4 Stock Number

The Stock Number data field includes the stock identification or national stock number, if the item has one.

### 3.1.5 Protection Type

The Protection Type data field identifies whether the equipment provides percutaneous (skin) and/or respiratory protection.

### 3.1.6 Equipment Category

The Equipment Category data field identifies if the equipment is self-contained breathing apparatus (SCBA), powered air purifying respirator (PAPR), tethered air, and/or canister.

### 3.1.7 Availability

The Availability data field refers to how readily available a piece of equipment is (e.g., how long it takes to receive equipment upon purchasing) or availability status of the equipment (e.g., commercial availability).

### 3.1.8 Current User

The Current User data field is used to identify organizations that are currently using the piece of equipment.

### 3.1.9 Manufacturer

The Manufacturer data field indentifies the company that manufactured the piece of equipment (to include the name, address, telephone number, and point-of-contact (POC)).

### 3.1.10 Manufacturer Type

The Manufacturer Type data field indicates whether the manufacturer is domestic or foreign.

### 3.1.11 Developer

The Developer data field identifies the organization that developed the item. This may be relevant when the developer is the government and the responsible technical agency may need to be identified.

### 3.1.12 Source

The Source data field indicates where the equipment information was obtained. Potential sources include past market surveys and Internet web sites.

### 3.1.13 Certification

The Certification data field identifies the agency certifying the system for use (i.e., OSHA, NIOSH, NFPA, etc.), if any.

## 3.2 Operational Parameters Category

The Operational Parameters Category includes the following five data fields:

1. Chemical Warfare (CW) Agents Protection.
2. Biological Warfare (BW) Agents Protection.
3. Toxic Industrial Materials (TIMs) Protection.
4. Duration of Protection.
5. Recommended Use(s).

Each of these data fields is defined in more detail in the remainder of this section.

### 3.2.1 Chemical Warfare (CW) Agents Protection

The Chemical Warfare Agents Protection data field indicates the type of chemical warfare (CW) agent. The most common types of classic CW agents are the nerve and blister agents. Nerve agents include GA (Tabun), GB (Sarin), GD (Soman), GF, and VX. Blister agents include H and HD (Sulfur Mustards), HN (Nitrogen Mustard), and L (Lewisite).

### 3.2.2 Biological Warfare (BW) Agents Protection

The Biological Warfare (BW) Agents Protection data field indicates the type of biological warfare (BW) agent. Classical BW agents include bacteria (Anthrax), rickettsia (Typhus), toxins (Botulinum Toxin), and viruses (Q Fever).

### 3.2.3 Toxic Industrial Materials (TIMs) Protection

The Toxic Industrial Materials (TIMs) Protection data field indicates the type of toxic industrial material (TIM) agent. TIMs are used in a variety of settings such as manufacturing facilities, maintenance areas, and storage areas. TIMs are further characterized by using a high, medium,

or low hazard index. Examples of TIMs are ammonia, carbon monoxide, chlorine, hydrogen cyanide, phosgene, and mineral acids (i.e., hydrochloric acid, sulfuric acid, and nitric acid).

### 3.2.4 Duration of Protection

The Duration of Protection data field indicates the amount of time the equipment provides adequate protection. Since duration varies depending on the concentration of agent, type of agent, and environmental conditions, duration will be given with respect to specific conditions.

### 3.2.5 Recommended Use(s)

The Recommended Use(s) data field identifies the areas where the equipment is most likely to be used per vendor or manufacturer recommendation (e.g., tactical operations, and crisis management).

## 3.3 Physical Parameters Category

The Physical Parameters Category includes the following data fields:

1. Sizes Available.
2. Weight.
3. Package Size and Volume.
4. Power Requirements.
5. Material Type (Percutaneous).
6. Construction Type (Percutaneous).
7. Color.

Each of these data fields is defined in more detail in the remainder of this section.

### 3.3.1 Sizes Available

The Sizes Available data field provides available sizes for an item, to include both male and female when appropriate.

### 3.3.2 Weight

The Weight data field indicates the total weight of the equipment/system.

### 3.3.3 Package Size and Volume

The Package Size and Volume data field provides the external dimensions of the system when packaged (for storage and transportability).

### 3.3.4 Power Requirements

The Power Requirements data field indicates the type of power (ac, dc, etc.) required to operate the equipment. This category applies primarily to respiratory, respiratory support equipment, and heating/cooling systems.

### 3.3.5 Material Type (Percutaneous)

The Material Type data field refers to the material content of the suit and the level of impermeability (i.e., impermeable, selectively permeable, or permeable). Note if the protective clothing is fire retardant or contains thermoplastic material (could potentially burn the wearer).

### 3.3.6 Construction Type (Percutaneous)

The Construction Type data field indicates how seams are sealed. This data field applies primarily to percutaneous equipment.

### 3.3.7 Color

The Color data field indicates if equipment has camouflage capability (signature reduction). Color can help identify job type.

## 3.4 Logistical Parameters Category

The Logistical Parameters Category includes the following data fields:

1. Ease of Use.
2. Consumables.
3. Maintenance Requirements.
4. Shelf Life.
5. Transportability.
6. Operational Limitations.
7. Environmental Conditions.
8. Unit Cost.
9. Maintenance Cost.
10. Warranty.
11. Don/Doff Information.
12. Use/Reuse.
13. Launderability (Percutaneous).
14. Accessories.

Each of these data fields is defined in more detail in the remainder of this section.

### 3.4.1 Ease of Use

Ease of Use is the mobility and flexibility of an individual while wearing the equipment as well as the compatibility of the equipment with other equipment.

### 3.4.2 Consumables

Consumables are the supplies used during operation and storage. Examples of consumables are batteries, canisters, hoses, etc.

### 3.4.3 Maintenance Requirements

Maintenance Requirements are the services and parts required to keep the system at its peak operational readiness (e.g., preventative maintenance) and the frequency of required maintenance (e.g., after use, quarterly, and annually).

### 3.4.4 Shelf Life

Shelf Life is the length of time a piece of equipment can be stored before it needs to be replaced. Shelf life includes the recommended storage procedure and any factors that decrease shelf life (e.g., UV, and critical temperature).

### 3.4.5 Transportability

Transportability is the ability of the equipment to be transported, including any support equipment (e.g., respiratory equipment, and heating/cooling systems).

### 3.4.6 Operational Limitations

Operational Limitations refer to the length of time responders can safely work at various temperatures (i.e., 50 °F, 70 °F, and 90 °F) and the availability/compatibility of cooling systems to help manage heat stress.

### 3.4.7 Environmental Conditions

Environmental Conditions indicate whether the equipment is designed for use in all common outdoor weather conditions and climates (e.g., rain, snow, extreme temperatures, and humidity) or only under relatively controlled conditions.

### 3.4.8 Unit Cost

Unit Cost is the cost of a complete system, including support equipment and operating costs (i.e., consumables).

### 3.4.9 Maintenance Cost

Maintenance Cost is the cost required to maintain the system at its operational readiness. This cost will be based on equipment usage rates.

### 3.4.10 Warranty

The Warranty is the length of time a piece of equipment is guaranteed by the manufacturer, including the terms of the warranty (parts and labor).

### 3.4.11 Don/Doff Information

The Don/Doff Information indicates whether the system requires assistance for donning and/or doffing and the average time for this activity.

### 3.4.12 Use/Reuse

Use/Reuse indicates the need for any part of the equipment to be discarded after use or its ability to be reused. The data field includes the procedures used to decontaminate and/or dispose of used equipment.

### 3.4.13 Launderability (Percutaneous)

Launderability includes the laundering procedures that are safe for the item, including the number of times the suit can be laundered and remain efficacious. Also, launderability includes any special procedures needed for specific components.

### 3.4.14 Accessories

Accessories include those items that are provided with the basic equipment.

## 3.5 Special Requirements Category

The Special Requirements Category includes the following data fields:

1. Training Requirements.
2. Training Available.
3. Manuals Available.
4. Surveillance Testing Requirements.
5. Support Equipment.
6. Testing Information.
7. Applicable Regulations.
8. Health Hazards.
9. Communications Interface Capability.
10. EOD Compatibility.

Each of these data fields is defined in more detail in the remainder of this section.

### 3.5.1 Training Requirements

The Training Requirements data field refers to the amount of instruction time the operator needs to become proficient in using a piece of equipment.

### 3.5.2 Training Available

The Training Available data field refers to training available from the manufacturer. This includes any initial training and recertification training that is available.

### 3.5.3 Manuals Available

The Manuals Available data field indicates the types of manuals available from the manufacturer (e.g., user manuals, and training documentation).

### 3.5.4 Surveillance Testing Requirements

The Surveillance Testing Requirements data field specifies the testing required to keep a piece of equipment at its operational readiness (e.g., inspecting respiratory masks or suits for holes or tears).

### 3.5.5 Support Equipment

The Support Equipment data field refers to any additional equipment required to operate the primary unit.

### 3.5.6 Testing Information

The Testing Information data field includes any test data obtained from the manufacturer and other sources regarding any part of the equipment (e.g., validation testing including materials and ensemble testing such as abrasion, tear, wear, burst, and permeation testing).

### 3.5.7 Applicable Regulations

The Applicable Regulations data field includes any government and/or safety regulations that may apply to the possession, use, or storage of any part of the system.

### 3.5.8 Health Hazards

The Health Hazards data field identifies all materials that possess a potential health hazard.

### 3.5.9 Communications Interface Capability

The Communications Interface Capability data field refers to the ability of the personal protective equipment to interface with a communications system (network capability, hardwire capability, and RF communication).

### 3.5.10 EOD Compatibility

The EOD Compatibility data field is the ability of the equipment to be used with EOD systems (i.e., suits). For example, a CB protective suit and respirator are required to be worn with an EOD suit in a CB environment.

# APPENDIX A—REFERENCES

## APPENDIX A—REFERENCES


1. Armando S. Bevelacqua and Richard H. Stilp, *Terrorism Handbook for Operational Responders*, Emergency Film Group, Edgartown, MA, January 1998.

2. Robert E. Hunt, Timothy Hayes, and Warren B. Carroll, *Guidelines for Mass Casualty Decontamination During a Terrorist Chemical Agent Incident*, Battelle, Columbus, OH, September 1999.

3. A.K. Stuempfle, D.J. Howells, S.J. Armour, and C.A. Boulet, *International Task Force 25: Hazard from Industrial Chemicals Final Report*, Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, MD, AD–B236562, ERDEC–SP–061, April 1998.

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5. *2000 Emergency Response Guidebook, A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident*, U.S. Department of Transportation, Research and Special Programs Administration, Tempest Publishing, Alexandria, VA, January 2000.

6. *Potential Military Chemical/Biological Agents and Compounds*, FM 3–9, AFR 355–7; NAVFAC P–467, Army Chemical School, Ft. McClellan, AL, December 12, 1990.

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8. Richard B. Belmonte, *Tests of Level A Suits—Protection Against Chemical and Biological Warfare Agents and Simulants: Executive Summary*, Soldier and Biological Chemical Command (SBCCOM), SCBRD-EN, Aberdeen Proving Ground, MD, June 1998.

9. Robert S. Lindsay, *Test Results of Level B Suits to Challenge by Chemical and Biological Warfare Agents and Simulants: Summary Report*, Soldier and Biological Chemical Command (SBCCOM), AMSSB-REN, Aberdeen Proving Ground, MD, April 1999.

# APPENDIX B—INDEX BY PERCUTANEOUS PROTECTIVE EQUIPMENT (APPAREL) IDENTIFICATION NUMBER

## *Index by Percutaneous Protective Equipment (Apparel) Identification Number*

| ID # | Percutaneous PPE (Apparel) Name | Manufacturer | Page E–# |
|---|---|---|---|
| 33 | Chemical Protective Butyl Rubber Gloves | Guardian Manufacturing Co. | 82 |
| 34 | Chemical Protective Butyl Rubber Gloves | Guardian Manufacturing Co. | 84 |
| 35 | Neoprene Gloves | Guardian Manufacturing Co. | 86 |
| 36 | NBC Casualty Bag | Irvin Aerospace Canada Ltd. | 88 |
| 37 | Kappler CPF 4 Bib Overall | Kappler Safety Group | 90 |
| 38 | Kappler CPF 4 Hood | Kappler Safety Group | 93 |
| 39 | Kappler CPF 4 Jacket | Kappler Safety Group | 96 |
| 40 | Lakeland Tychem® 10000 Level B Jacket | Lakeland Industries, Inc. | 99 |
| 41 | Lakeland Tychem® 10000 Level B Overalls | Lakeland Industries, Inc. | 101 |
| 42 | Lakeland Tychem® 10000 Level B Hood | Lakeland Industries, Inc. | 103 |
| 43 | Lakeland Tychem® 10000 Level B Apron | Lakeland Industries, Inc. | 105 |
| 44 | Lakeland Tyvek® QC Level B Jacket | Lakeland Industries, Inc. | 107 |
| 45 | Lakeland Tyvek® QC Level B Pants | Lakeland Industries, Inc. | 109 |
| 46 | Lakeland Tyvek® QC Level B Hood | Lakeland Industries, Inc. | 111 |
| 47 | Lakeland Tyvek® QC Level B Sleeves | Lakeland Industries, Inc. | 113 |
| 48 | Lakeland Tychem® SL Level B Hood | Lakeland Industries, Inc. | 115 |
| 49 | Lakeland Tychem® SL Level B Hood | Lakeland Industries, Inc. | 117 |
| 50 | Lakeland Tychem® SL Level B Apron | Lakeland Industries, Inc. | 119 |
| 51 | Lakeland Tychem® SL Level B Boots | Lakeland Industries, Inc. | 121 |
| 52 | Lakeland Tychem® SL Level B Sleeves | Lakeland Industries, Inc. | 123 |
| 53 | Lakeland Tychem® 9400 Level B Jacket/Pants | Lakeland Industries, Inc. | 125 |
| 54 | Lakeland Tychem® 9400 Level B Hood | Lakeland Industries, Inc. | 127 |
| 55 | Lakeland Tychem® 9400 Level B Hood | Lakeland Industries, Inc. | 129 |
| 56 | Lakeland Tychem® 9400 Level B Apron | Lakeland Industries, Inc. | 131 |
| 57 | Lakeland Tychem® 9400 Level B Sleeves | Lakeland Industries, Inc. | 133 |
| 58 | Lakeland Tychem® 9400 Level B Boot Covers | Lakeland Industries, Inc. | 135 |
| 59 | Chemical Protective Undergarment (CPU) | LANX Fabric Systems | 137 |
| 60 | Escape Jacket C/92F with optional Escape Hood | New Pac Safety AB | 140 |
| 61 | PONCHO NP/60 | New Pac Safety AB | 142 |
| 62 | North Silver Shield Gloves | North | 144 |
| 63 | Rocky Shoes and Boots | Rocky Shoes and Boots, Inc. | 146 |
| 64 | Servus HZT Hazmat Knee Boot | Servus Firefighter Footwear | 148 |

# APPENDIX C—INDEX BY PERCUTANEOUS PROTECTIVE EQUIPMENT (APPAREL) NAME

## *Index by Percutaneous Protective Equipment (Apparel) Name*

| *Percutaneous PPE (Apparel) Name* | *Manufacturer* | *ID #* | *Page E–#* |
|---|---|---|---|
| Lakeland Tychem® 9400 Level B Hood | Lakeland Industries, Inc. | 55 | 129 |
| Lakeland Tychem® 9400 Level B Jacket/Pants | Lakeland Industries, Inc. | 53 | 125 |
| Lakeland Tychem® 9400 Level B Sleeves | Lakeland Industries, Inc. | 57 | 133 |
| Lakeland Tychem® SL Level B Apron | Lakeland Industries, Inc. | 50 | 119 |
| Lakeland Tychem® SL Level B Boots | Lakeland Industries, Inc. | 51 | 121 |
| Lakeland Tychem® SL Level B Hood | Lakeland Industries, Inc. | 48 | 115 |
| Lakeland Tychem® SL Level B Hood | Lakeland Industries, Inc. | 49 | 117 |
| Lakeland Tychem® SL Level B Sleeves | Lakeland Industries, Inc. | 52 | 123 |
| Lakeland Tyvek® QC Level B Hood | Lakeland Industries, Inc. | 46 | 111 |
| Lakeland Tyvek® QC Level B Jacket | Lakeland Industries, Inc. | 44 | 107 |
| Lakeland Tyvek® QC Level B Pants | Lakeland Industries, Inc. | 45 | 109 |
| Lakeland Tyvek® QC Level B Sleeves | Lakeland Industries, Inc. | 47 | 113 |
| Multi Plus-HazMat/Toxic Protective Glove | COMESEC Safety Inc. | 10 | 19 |
| NBC Casualty Bag | Irvin Aerospace Canada Ltd. | 36 | 88 |
| NBC Gloves | Goetzloff GmbH | 30 | 76 |
| NBC Multi-Purpose Safety Boot | Acton International Inc. | 2 | 3 |
| Neoprene Gloves | Guardian Manufacturing Co. | 35 | 86 |
| North Silver Shield Gloves | North | 62 | 144 |
| Personal Ice Cooling System (PICS) | GEOMET Technologies, Inc. | 73 | 166 |
| PONCHO NP/60 | New Pac Safety AB | 61 | 142 |
| Rocky Shoes and Boots | Rocky Shoes and Boots, Inc. | 63 | 146 |
| Saratoga Chemical Protective Gloves | Tex-Shield, Inc. | 65 | 150 |
| Saratoga Chemical Protective Socks | Tex-Shield, Inc. | 66 | 152 |
| Saratoga Chemical Protective Undergarment | Tex-Shield, Inc. | 67 | 154 |
| Servus HZT Hazmat Knee Boot | Servus Firefighter Footwear | 64 | 148 |
| Tingley Hazproof Overboot | Tingley Rubber Corporation | 68 | 156 |
| Toxicological Agent Protective (TAP) Boot | Acton International Inc. | 1 | 1 |
| Tychem® BR Hood/Vest | DuPont Tyvek® Protective Apparel | 27 | 68 |
| Tychem® QC Hood | DuPont Tyvek® Protective Apparel | 24 | 59 |
| Tychem® QC Hood | DuPont Tyvek® Protective Apparel | 25 | 62 |
| Tychem® QC Labcoat | DuPont Tyvek® Protective Apparel | 21 | 50 |
| Tychem® QC Pants | DuPont Tyvek® Protective Apparel | 23 | 56 |
| Tychem® QC Shirt | DuPont Tyvek® Protective Apparel | 22 | 53 |

| *Percutaneous PPE (Apparel) Name* | *Manufacturer* | *ID #* | *Page E–#* |
|---|---|---|---|
| Tychem® SL Hood | DuPont Tyvek® Protective Apparel | 26 | 65 |
| Tychem® TK Hood/Vest | DuPont Tyvek® Protective Apparel | 28 | 71 |
| Tyvek® Hood | DuPont Tyvek® Protective Apparel | 18 | 41 |
| Tyvek® Hood | DuPont Tyvek® Protective Apparel | 19 | 44 |
| Tyvek® Hood | DuPont Tyvek® Protective Apparel | 20 | 47 |
| Tyvek® Labcoat | DuPont Tyvek® Protective Apparel | 12 | 23 |
| Tyvek® Labcoat | DuPont Tyvek® Protective Apparel | 13 | 26 |
| Tyvek® Labcoat | DuPont Tyvek® Protective Apparel | 15 | 32 |
| Tyvek® Labcoat | DuPont Tyvek® Protective Apparel | 16 | 35 |
| Tyvek® Pants | DuPont Tyvek® Protective Apparel | 17 | 38 |
| Tyvek® Shirt | DuPont Tyvek® Protective Apparel | 14 | 29 |
| Weapons of Mass Destruction (WMD) Contamination Containment Bag | ILC Dover, Inc. | 69 | 158 |

# APPENDIX D—INDEX BY PERCUTANEOUS PROTECTIVE EQUIPMENT (APPAREL) MANUFACTURER

## *Index by Percutaneous Protective Equipment (Apparel) Manufacturer*

| *Manufacturer* | *Percutaneous PPE (Apparel) Name* | *ID #* | *Page E–#* |
|---|---|---|---|
| Guardian Manufacturing Co. | Chemical Protective Butyl Rubber Gloves | 33 | 82 |
| Guardian Manufacturing Co. | Chemical Protective Butyl Rubber Gloves | 34 | 84 |
| Guardian Manufacturing Co. | Neoprene Gloves | 35 | 88 |
| ILC Dover, Inc. | Chemical-Biological Eye/Respiratory Disposable (C-BERD) Hood/Mask | 70 | 160 |
| ILC Dover, Inc. | ILC Model 15 Cool Vest | 71 | 162 |
| ILC Dover, Inc. | ILC Model 19 Cool Vest | 72 | 164 |
| ILC Dover, Inc. | Weapons of Mass Destruction (WMD) Contamination Containment Bag | 69 | 158 |
| INTERSPIRO INC. | Flexi ICE Cold Vest | 74 | 169 |
| Irvin Aerospace Canada Ltd. | NBC Casualty Bag | 36 | 93 |
| Kappler Safety Group | Kappler CPF 4 Bib Overall | 37 | 90 |
| Kappler Safety Group | Kappler CPF 4 Hood | 38 | 93 |
| Kappler Safety Group | Kappler CPF 4 Jacket | 39 | 96 |
| Lakeland Industries, Inc. | Lakeland Tychem® 10000 Level B Apron | 43 | 110 |
| Lakeland Industries, Inc. | Lakeland Tychem® 10000 Level B Hood | 42 | 103 |
| Lakeland Industries, Inc. | Lakeland Tychem® 10000 Level B Jacket | 40 | 99 |
| Lakeland Industries, Inc. | Lakeland Tychem® 10000 Level B Overalls | 41 | 101 |
| Lakeland Industries, Inc. | Lakeland Tychem® 9400 Level B Apron | 56 | 131 |
| Lakeland Industries, Inc. | Lakeland Tychem® 9400 Level B Boot Covers | 58 | 135 |
| Lakeland Industries, Inc. | Lakeland Tychem® 9400 Level B Hood | 54 | 127 |
| Lakeland Industries, Inc. | Lakeland Tychem® 9400 Level B Hood | 55 | 129 |
| Lakeland Industries, Inc. | Lakeland Tychem® 9400 Level B Jacket/Pants | 53 | 125 |
| Lakeland Industries, Inc. | Lakeland Tychem® 9400 Level B Sleeves | 57 | 133 |
| Lakeland Industries, Inc. | Lakeland Tychem® SL Level B Apron | 50 | 119 |
| Lakeland Industries, Inc. | Lakeland Tychem® SL Level B Boots | 51 | 121 |
| Lakeland Industries, Inc. | Lakeland Tychem® SL Level B Hood | 48 | 115 |
| Lakeland Industries, Inc. | Lakeland Tychem® SL Level B Hood | 49 | 117 |
| Lakeland Industries, Inc. | Lakeland Tychem® SL Level B Sleeves | 52 | 123 |
| Lakeland Industries, Inc. | Lakeland Tyvek® QC Level B Hood | 46 | 111 |
| Lakeland Industries, Inc. | Lakeland Tyvek® QC Level B Jacket | 44 | 107 |
| Lakeland Industries, Inc. | Lakeland Tyvek® QC Level B Pants | 45 | 109 |
| Lakeland Industries, Inc. | Lakeland Tyvek® QC Level B Sleeves | 47 | 113 |

| *Manufacturer* | *Percutaneous PPE (Apparel) Name* | *ID #* | *Page E–#* |
|---|---|---|---|
| LANX Fabric Systems | Chemical Protective Undergarment (CPU) | 59 | 137 |
| New Pac Safety AB | Escape Jacket C/92F with optional Escape Hood | 60 | 140 |
| New Pac Safety AB | PONCHO NP/60 | 61 | 142 |
| North | North Silver Shield Gloves | 62 | 144 |
| Rocky Shoes and Boots, Inc. | Rocky Shoes and Boots | 63 | 146 |
| Servus Firefighter Footwear | Servus HZT Hazmat Knee Boot | 64 | 148 |
| Tex-Shield, Inc. | Saratoga Chemical Protective Gloves | 65 | 150 |
| Tex-Shield, Inc. | Saratoga Chemical Protective Socks | 66 | 152 |
| Tex-Shield, Inc. | Saratoga Chemical Protective Undergarment | 67 | 154 |
| Tingley Rubber Corporation | Tingley Hazproof Overboot | 68 | 156 |
| Wells Lamont | Integrated Chemical Biological Protective Glove | 29 | 74 |

## APPENDIX E—PERCUTANEOUS PROTECTIVE EQUIPMENT (APPAREL) DATA SHEETS

CLICK TO VIEW SEPARATE FILES: Pp. 1–55, Pp. 56-110, Pp. 111-170